UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
WESTERN DIVISION

TOM KONDASH, on behalf of himself and all others similarly situated,	)	Case No. 1:15-cv-506
Plaintiff,	)	
v.	)	**DECLARATION OF THOMAS READ IN SUPPORT OF PLAINTIFF'S MOTION FOR CLASS CERTIFICATION**
KIA MOTORS AMERICA, INC., and **KIA MOTORS CORPORATION**,	)	
Defendants.	)	

I, Thomas Read, declare as follows:

1. Read Consulting has been asked by counsel for Plaintiffs to evaluate the Kia vehicles with panoramic sunroofs in this litigation, to assist in explaining technical details that may be relevant in the case, and to consider whether or not there is evidence of a defect. I evaluated their design and performance and am prepared to use my background, knowledge, and review of information in this case to explain the technical issues and to provide the below opinions.

2. As set forth in detail below, I conclude that the Subject Vehicles[1] share a common defect, which is that their panoramic sunroofs contain large, thin, curved, and weakened glass that cannot withstand the applied tensile stresses of their operating environment resulting in abrupt glass shattering. The inability to withstand these stresses can and will lead to a substantial likelihood of abrupt glass shattering when the vehicles are driven.

[1] I refer to the vehicles I have analyzed as "Subject Vehicles." They fall within the following model years:

- 2011-2015 Kia Sorento, Optima, Optima Hybrid, and Sportage; and
- 2014-2015 Kia Cadenza.

3. The panoramic sunroofs in this case have substantially common design features, as discussed below, including their size, thickness, curvature, connection to the vehicles' unibody frames, and use of ceramic paint or frit. Accordingly, it is my considered opinion that the defect described in this declaration is common to the Subject Vehicles.

4. I reserve the right to supplement this declaration as more information becomes available.

My Experience

5. I am a licensed manufacturing engineer with over 40 years of experience involving glass, including in glass failure analysis. My initial introduction to glass failure analysis began in 1972 at Corning Glass Works where I developed finishing processes for the NASA Space Shuttle windows. This work included preparing test plates, breaking them under controlled conditions and analyzing the failure.

6. I have a B.S. in Metallurgy from the University of Pennsylvania, an M.S. in Materials Science from Stanford University and a Ph.D. in Materials Science and Engineering also from Stanford University. A current CV is attached as Appendix A.

7. I am a licensed manufacturing engineer in the state of California. Presently I am a self-employed engineering consultant. I consult with numerous manufacturing companies in the area of glass fracture, and also consult with attorneys on product liability cases involving glass fractures.

8. My involvement in working with glass, tempered glass, glass failure analysis, and related subjects began in 1972 at Corning Glass Works where I developed the finishing processes for glass computer disks and windows for the NASA Space Shuttle. Included in these projects were the strength testing of representative coupons (specially prepared test samples) and the

follow-on failure analysis of the broken coupons. At this time I was also involved with setting up a process for chemically tempering glass. Since that time, I have performed hundreds of glass failure analyses. These include over 70 tempered glass failures. In addition, I have performed for various manufacturers qualification tests on numerous tempered glass parts (pot covers, toaster oven doors and tempered glass windows).

9. I have been qualified to testify in trial as an expert in failure analysis at least forty times. A list of depositions and trials at which I have testified for the last four years, along with my list of publications for the last ten years, is attached as Appendix B.

10. My compensation for this case is $300.00/hour, and it is not dependent on the content of this report, any testimony I may give, or the outcome of this case.

11. In forming my opinions, I have relied upon my background and experience as set forth above, and these documents and items:

- Documents produced by Defendants Kia Motors America, Inc. and Kia Motors Corporation in this case
- Documents from U.S. and foreign government investigations of panoramic sunroofs
- Declaration of Neil Hannemann
- Engineering literature relative to steering failure
- Panoramic sunroof parts for the Kia vehicles at issue

<u>Sunroofs Generally</u>

12. A sunroof is an opening in an automobile roof that allows light and may allow fresh air to enter the passenger compartment. A panoramic sunroof is a larger opening in the

automobile's rooftop that uses a glass panel system. The glass panels cover a large portion of the roof area and can consist of fixed and moveable glass panels.[2]

Sunroof Glass

13. Generally speaking, glass is made by fusing silica, soda, lime, and depending on its intended use, other ingredients. Typically, glass is transparent and can be given different tints and strengths depending on its intended use.

14. When designing a product with glass, engineers should understand the tensile stresses that will be applied to the glass, as well as the environment, and consequences of any failure. In most contexts, non-defective thermally tempered glass will not shatter under typical and foreseeable use within its expected environment.

15. Annealed glass is glass that is essentially stress free. These are typically used on consumer products such as glass bottles, drinking glasses, home windows, etc. When annealed glass fails, it breaks into shards.

16. Safety or toughened glass, also known as tempered glass, is glass that is heat-treated and is stronger than annealed glass. When tempered glass fails it breaks into smaller pieces than annealed glass, and for this reason is considered safer. However, smaller, tempered glass pieces still have sharp edges. Typical uses of tempered glass include car side windows, glass windows for liquid gauges, transparent lids for pots, and cooking ware.

17. Laminated glass is another type of safety glass that consists of layers of annealed glass held together with a polymer layer. When laminated glass breaks, it doesn't break into small pieces. Typical use is the windshield of a car, but it is also used in some furniture applications.

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[2] Complaint, General Order Directed to Motor Vehicle Manufacturers, https://static.nhtsa.gov/odi/inv/2014/INLM-EA14002-63477.pdf at 3

18. Glass only fails in tension as depicted below in Figure #1. Glass can be tempered, which means the outer surfaces of the glass are put into compression. For this reason, thermal temper processes were developed. Thermal tempering is the process of adding surface compression to glass making it stronger.

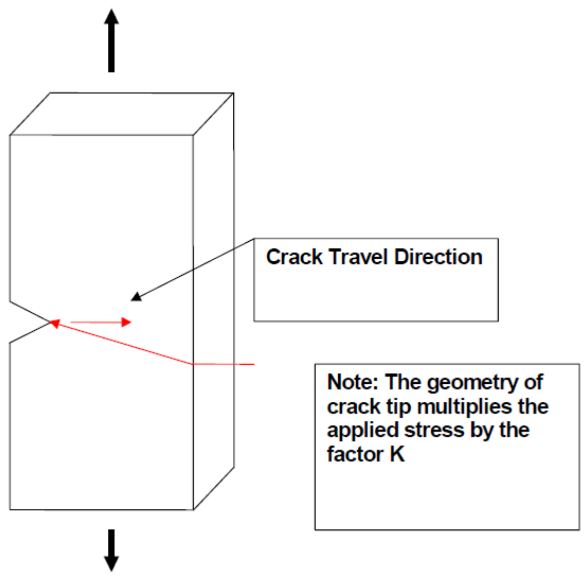

Figure #1: Illustration demonstrating the only failure mode of glass.

19. There are two categories of thermally tempered glass:

a. Fully Tempered Glass: Glass that has a minimum of 10,000 psi compressive stress on both surfaces.

b. Heat Strengthened Glass: Glass that has from 4500 to 7500 psi compressive stress on both surfaces.

20. Because stresses are additive, for glass that has surface compression, the residual surface compressive stresses need to be overcome before the surface can be put in tension. Once the applied tensile stress overcomes the compressive stresses (and the normal actual glass breaking stress) the glass fails.

21. In the case of the subject panoramic sunroofs, which are all made with thermally tempered glass, the sunroofs theoretically should be stronger and more resistant to thermal shock and mechanical damage than annealed glass.

The Defective Panoramic Sunroofs in Subject Vehicles

22. According to Kia, the panoramic sunroof feature was first introduced in the 2011 Kia Sorento.[3] Subject Vehicles were all designed and manufactured to include a factory-installed panoramic sunroof assembly. The panoramic sunroof assemblies were manufactured by Webasto Donghee and Webasto Roof Systems, Inc.[4] A panoramic sunroof assembly for the Sorento is pictured below.

Figure #2: Kia illustration of panoramic sunroof assembly for the Optima viewed from below. [5]

[3] KMA(NHTSA)00011580
[4] KMA(NHTSA)00011588
[5] KMA00012567

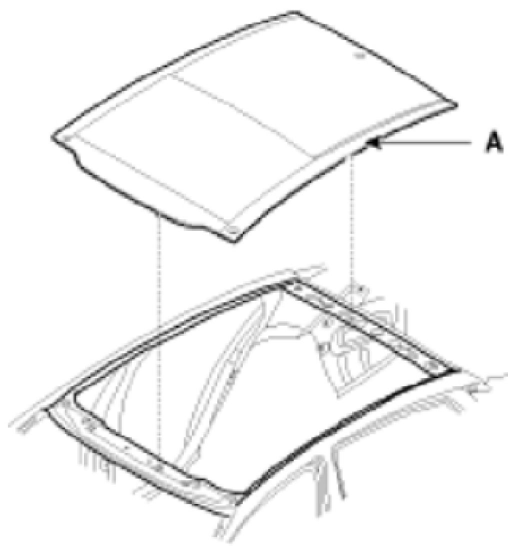

Figure #3: Kia illustration of installation of panoramic sunroof assembly on Optima.[6]

23. Each panoramic sunroof assembly in Subject Vehicles is composed of two or three glass panels that fit within a stiff sunroof frame.[7] Each assembly includes one moving panel which operates in a tilt and slide design.[8] Each panel must be sealed to the frame assembly so that environmental forces like wind and precipitation do not enter the vehicle. Stress is applied to the glass panels in order to ensure a proper seal.

24. Each glass panel is affixed to the sunroof frame through a sealant or fasteners.[9] The sunroof frame is affixed to the vehicle frame via fasteners. The sunroof frame is then attached to the roof. It is my understanding that these vehicles utilize a unibody construction which means that the entire body of the car handles and absorbs the loads and stresses applied to the vehicle.

[6] KMA00012574
[7] KMA(NHTSA)00011588-89
[8] KMA(NHTSA)00011588-89
[9] Perez Depo. 119:25-121

25. The panoramic sunroofs in Subject Vehicles utilize glass panels composed of tempered glass. The sunroofs are all large and take a substantial portion of the vehicle roof.[10] Traditional sunroofs have been only a fraction of this size.

26. The glass panels in Subject Vehicles are curved.[11] The sunroof panels are large bowed pieces of tempered glass. It is helpful to think of the sunroof panel as a large glass membrane that can flex from various externally applied forces. The sunroof glass starts as an extremely flat piece of float glass, which is glass made by floating molten glass on molten metal. The glass panels are shaped in a process called slumping by using a forming tool. This process does not produce an accurate shape. There will be stresses produced when the sunroofs are affixed to the frame.

27. The Subject Vehicles utilize glass panels that are all 4 mm thick.

	Thickness of glass panels in millimeters[12]		
Model	Front	Movable	Rear
Sorento (2011-2013 MY)	-	4mm	4mm
Sorento (2014-2015 MY)	4mm	4mm	4mm
Optima/Optima Hybrid (2011-2015 MY)	4mm	4mm	4mm
Sportage (2011-2015 MY)	4mm	4mm	4mm
Cadenza (2014-2015 MY)	4mm	4mm	4mm

Increasing glass size without increasing glass thickness makes the glass more vulnerable under applied loads. Similarly, the protective compression layer decreases as the thickness decreases.

[10] KMA(NHTSA)00011588
[11] Kim Depo. 24:14-16
[12] KMA(NHTSA)00011588

28. The glass panels also utilize a ceramic print around the outer border of each panel. Ceramic print is a mixture of ceramic frit and polymer binders that are painted on the glass surface and baked (and is sometimes referred to simply as frit or enamel). The ceramic print covers a significant portion of the glass area in Subject Vehicles, ranging from 40-60 percent of the total glass area.[13] These figures are above the average area of ceramic print area in sunroofs (33-37 percent) cited in the Overall Review of ceramic print produced by the Korean Government.[14] According to deposition testimony from a Kia engineer, the size of the ceramic print is selected to be sufficient to cover interior structures.[15] As discussed below, ceramic frit reduces the strength of the glass.

29. It is also important to consider the environment and tensile stresses to which it will be exposed. Glass generally, and sunroof glass in particular, is designed and expected to sustain moderate impacts without shattering. When glass is used in sunroofs, there are numerous sources of tensile stresses on the glass, including:

a. Mounting mismatched glass to a stiff sunroof frame;

b. Affixing the frame to the vehicle;

c. Clamping pressure applied to the sunroof to close it and keep it attached to the vehicle;

d. Thermal shock from heating and cooling;

e. Flexing of the glass during driving;

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[13] PSG Research results on CPA in Korean Industry (https://www2.unece.org/wiki/download/attachments/29885103/PSG-06-03%20Research%20results%20on%20CPA%20in%20Korean%20industry%28July%202015%29.pdf?api=v2)

[14] Overall Review of CPA, https://www2.unece.org/wiki/download/attachments/26902754/PSG-02-04-Overall_Review_of_CPA.pdf?api=v2

[15] Kim Depo. 42:14-23

f. Road vibrations and bumps;

g. Changes in pressure, e.g., closing and opening windows and doors and pressures created from driving;

h. Reduced compressive stress at the panel edges; and

i. Minor and foreseeable impacts (e.g., hail or gravel or pebbles kicked up off the road).

30. Key factors for choosing glass for application in sunroofs include glass thickness, weight, size of glass, type of glass, and strength of glass.

31. Given the size, thinness, curvature, ceramic print, and attachment to the unibody frame, the panoramic sunroof glass in Subject Vehicles is weakened and not capable of withstanding the tensile stresses one would reasonably anticipate, making the glass defective in that it is substantially likely to shatter and not reasonably fit for its intended use and environment. In other words, the panoramic sunroofs in Subject Vehicles will experience glass shattering in connection with the tensile stresses discussed above, even though those forces are not capable of shattering non-defective sunroofs.

32. The glass used in the Subject Vehicles' panoramic sunroofs needs to be able to withstand tensile stresses above 10,000 psi in order to be considered tempered safety glass. The glass used in Subject Vehicles' sunroofs is not performing to this standard and fail at much lower tensile loads than the 10,000 psi standard.

Subject Vehicle Panoramic Sunroof Failures

33. It appears many of the panoramic sunroofs in Subject Vehicles have already shattered, to the concern of Kia, governments, and drivers.

34. Based on the documents I have seen, multiple government agencies have opened investigations on panoramic sunroof breakage in Subject Vehicles. For example, in October 2013, the NHTSA began investigating panoramic sunroof breakage in the 2011-2013 Kia Sorento.[16] In a June 2016 response to a NHTSA inquiry, Kia identified over 600 incidents involving an allegation of spontaneous shattering of the panoramic sunroof in the U.S. and Canada in the Subject Vehicles.[17]

35. Noticing a sharp rise in customer complaints between 2011 and 2013, the Korea Automobile Testing & Research Institute (KATRI), a Korean government body, opened a safety investigation into panoramic sunroofs.[18] The investigation was in response to driver complaints of reported sudden and unexpected shattering of panoramic sunroofs, which can lead to drivers suffering abrasions due to shattered glass, as well as driver distraction.[19] After an investigation that involved inspecting and testing panoramic sunroof glass, the KATRI found that the frit, the paint used for the ceramic print area of automotive glazing, is a known adulterant and weakens sunroofs' strength.[20] KATRI found that ceramic printed sunroof glazing is weaker than original,

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[16] https://static.nhtsa.gov/odi/inv/2013/INIM-PE13035-57934.pdf?_ga=1.241146628.627498399.1492378133
[17] KMA(NHTSA)00011650-51
[18] Defect Investigation on Panoramic Sunroof in Korea, https://www.unece.org/fileadmin/DAM/trans/doc/2014/wp29grsg/GRSG-106-21e.pdf at page 8
[19] Defect Investigation on Panoramic Sunroof in Korea, https://www.unece.org/fileadmin/DAM/trans/doc/2014/wp29grsg/GRSG-106-21e.pdf at page 8
[20] Defect Investigation on Panoramic Sunroof in Korea, https://www.unece.org/fileadmin/DAM/trans/doc/2014/wp29grsg/GRSG-106-21e.pdf at page 13; Overall Review of CPA,

non-heat strengthened glass and is vulnerable to impacts or vibration leading to the total failure of the glass.[21] Images of the ceramic print's effect on glass is below.

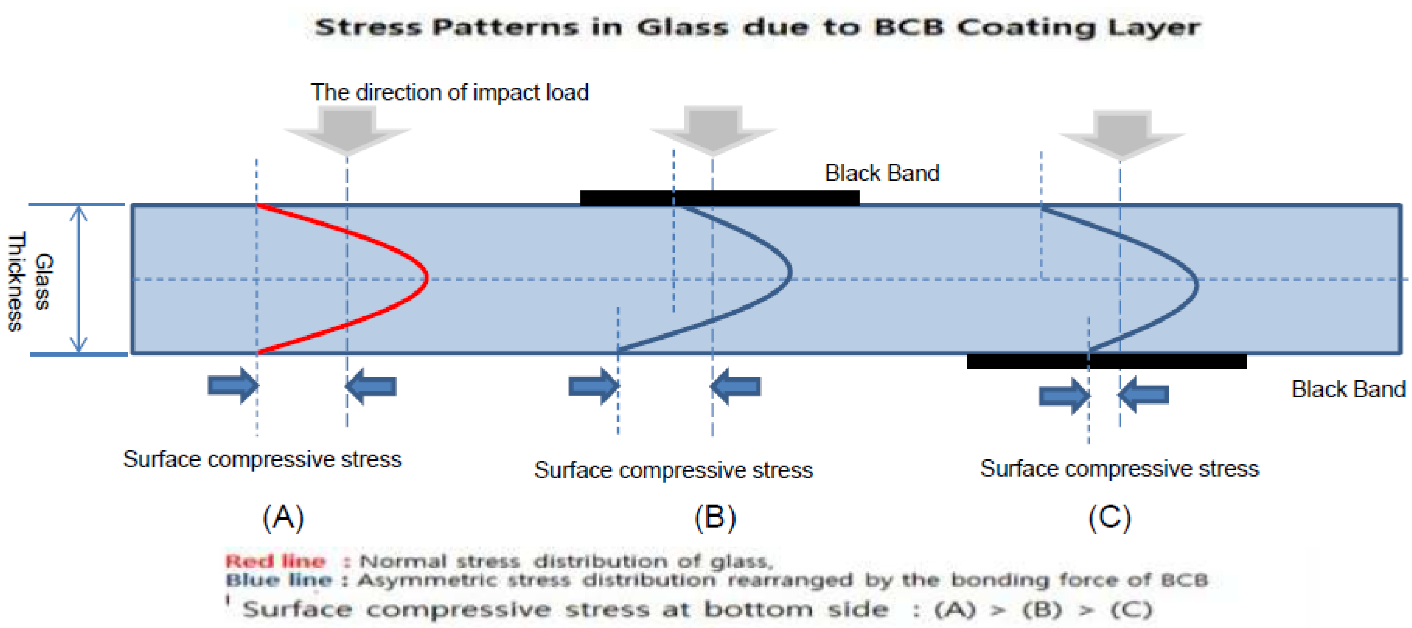


Figure #4: Kia schematic diagram showing the effect of printed and fired frit on the stress profile of a fully tempered piece of glass.[22]

https://www2.unece.org/wiki/download/attachments/26902754/PSG-02-04-Overall_Review_of_CPA.pdf?api=v2 at page 15
[21] Defect Investigation on Panoramic Sunroof in Korea, https://www.unece.org/fileadmin/DAM/trans/doc/2014/wp29grsg/GRSG-106-21e.pdf
[22] KMC00003085

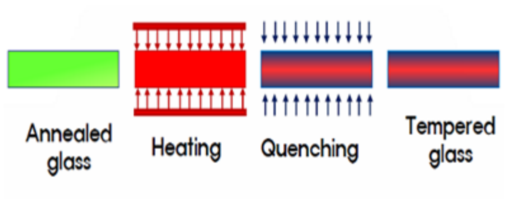
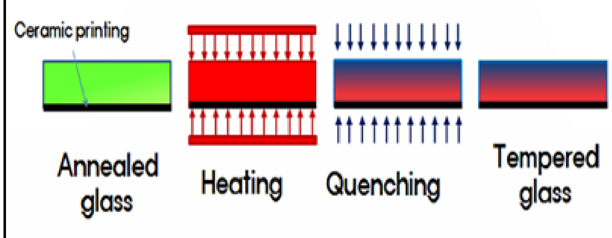
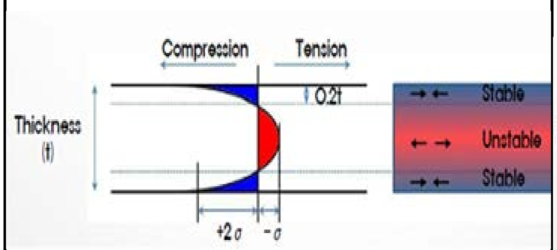
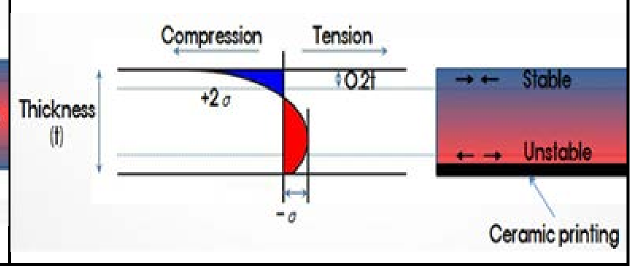
	Toughened Glass	**Toughened Glass With CPA (Ceramic Print Area)**
Process		
Stress Distribut-ion		

Figure #5: Another schematic showing the effect of the ceramic print area (CPA) on the stress profile of fully tempered glass. Notice that glass surface in contact with ceramic printing is no longer in compression. Therefore, in this region, this is not tempered glass.[23]

36. Customer complaints produced by Kia and available on the NHTSA's website also demonstrate that a significant number of sunroof breakage events occurred while Subject Vehicles were stationary or in a low-speed situation. This suggests that other events stress the glass to the point of breakage. A selection of incident reports are included below:

2012 Kia Sportage:

1. I noticed the sunroof was collapsed into the bottom part it just shattered

[23] Overall Review of CPA, https://www2.unece.org/wiki/download/attachments/26902754/PSG-02-04-Overall_Review_of_CPA.pdf?api=v2 at page 14

2. I rode it yesterday and I came home 9:00
3. It has not moved it is still in the parking garage now

. . . .

1. It was parked inside my house garage
2. I parked it at 9 o clock last night
3. When I went back to my garage at 9 am this morning, I noticed it was shattered[24]

2011 Kia Sorento:
1. I am a vendor and sell to the plant in Georgia.
2. Vehicle was sitting outside in a parking lot.
3. When I come out, there was glass all over.
4. There was a cop there and said it blew out from the heat.
5. I took vehicle into dealer svc dept because I couldn't drive it like that.
6. Dealer svc dept said I would have to pay for it.
7. Was told that something hit it.[25]

2014 Kia Cadenza:
Customer states:
1. It's under husband's name
2. It was under the garage, this was a Thursday
3. I had it parked there for 2 weeks because I go to school full time
4. I was going to take it to school on a Friday
5. I was going to vacuum my car so I got inside
6. As soon as I closed the door, the sunroof shattered
7. The car wasn't even hot[26]

2011 Kia Sorento:
1. It was raining, roads were smooth.
2. There were no rocks or debris on the road.
3. No rocks or anything hit the hood or windshield prior to shatter.
4. We were slowing down approaching a stop light which was turning yellow.
5. We were going about 25 mph at the time of the shatter.
6. It happened before we got to the stop light.
7. My husband took a picture of the damage to the sunroof and a picture of the road where it happened . . .[27]

2012 Kia Sorento:
1. I was told to call you before they will fix my sunroof.

[24] KMA00018282
[25] KMA00016056
[26] KMA00014249
[27] KMA00016932

2. They took lots of pictures at the dealership.
3. I was going over the rail road tracks, and it rained down on me.
4. I have crossed that railroad track more than a few times and this has never happened.
5. It sounded like a gun shot inside the car.
6. Then glass rained down on me.
7. The whole front panel is broken.
8. I had just opened it.
9. I don't recall any other windows being open in the vehicle at all.[28]

<u>2012 Kia Optima</u>:

6. On Friday I took my wife out on a date, vehicle was driving just fine.
7. Saturday morning I took my dog for a walk around 11 am, my wife went to take the vehicle out around 2:00 pm and discovered that the sunroof was shattered

. . . .

16. **Where did the incident occur?**
D. Parked
41. **Where was your vehicle parked? (e.g. covered parking garage, personal garage, open parking lot, driveway street.)**
Please describe where the vehicle was parked.:
covered personal garage[29]

<u>2014 Kia Optima</u>:

Customer alleges:

1. On Monday, we were driving the vehicle and the sunroof exploded
2. Dlr told us that KMA said they'll not be covering the window
3. Nothing struck the sunroof
4. It exploded outward

. . . .

17. How fast was the vehicle moving (MPH/Stationary)?
About 5-10mph
18. Describe traffic conditions around you [how close was the nearest vehicle to you and what type of
There were no vehicles near me
19. What was the condition of the highway/interstate (e.g., freshly paved, some roughness, had some
Was not on the highway/interstate
Street was smooth and new[30]

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[28] KMA00016316

[29] KMA00014876, KMA00014887

[30] KMA00015361, KMA00015365

2013 Kia Optima:
Cust States:
8. My daughter [Redacted] walked in the garage and came back in and said the roof was making noise
9. I walked out there and it was making a cracking noise
10. You couldn't really tell until you get closer that it was the glass
11. All of a sudden poof and it caved in

. . . .

17. How fast was the vehicle moving (MPH/Stationary)?
Stationary or Parked[31]

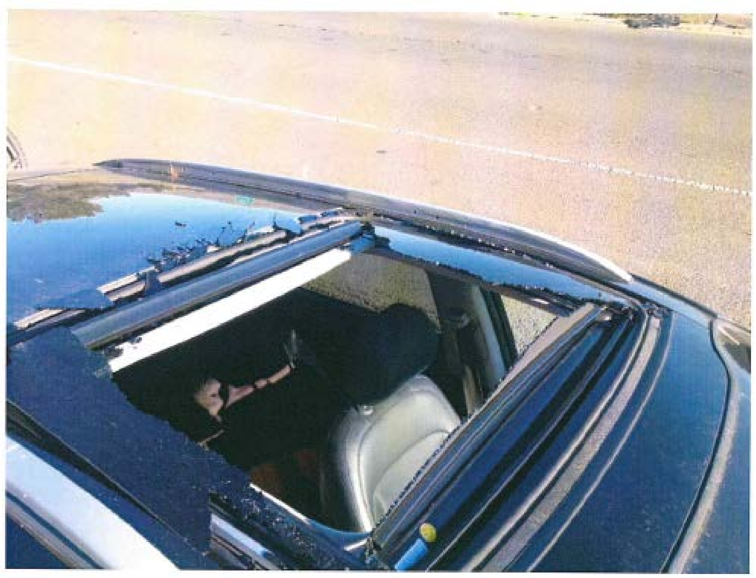
2015 Kia Cadenza
The caller states:
1. Performance Kia wants me to call you about the sunroof imploding
2. Performance Kia says they are not allowed to fix this until I speak with you
3. I was not with the vehicle when the sunroof imploded
4. It was at Performance Kia being worked on
5. So why do I need to call?[32]

2015 Kia Sportage:
cust states:
1. I called the dlr and spoke with Chris Sing, my sunroof broke and it is at my house
2. have not taken it to the dealer, it broke in my garage. I noticed water coming in and my husband looked at it.
3. He noticed it had broken in a million pieces[33]

[31] KMA00015761
[32] KMA00020123
[33] KMA00020347

37. Below are exemplar photographs of Subject Vehicles with broken sunroofs:

Figure #6: Above is a photograph of a 2014 Kia Optima with a broken sunroof produced by Kia to NHTSA.[34]



K2863751

Figure #7: Above is a photograph of a 2012 Kia Sportage with a broken sunroof produced by Kia to NHTSA.[35]

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[34] Kia Optima Consumer Complaints, https://static.nhtsa.gov/odi/inv/2014/INRD-EA14002-62080P.PDF

[35] Kia Sportage Consumer Complaints, https://static.nhtsa.gov/odi/inv/2014/INRD-EA14002-62079P.PDF

Figure #8: Above is a photograph of a 2014 Kia Sorento with a broken sunroof produced by Kia to NHTSA.[36]

38. Kia has also tracked the issue internally, including through quality information reports.[37]

The Science of Glass Failure Analysis

39. Below is a description of glass failure analysis. This technique applies to both annealed and tempered glass. However, the examples given below will be of tempered glass failures.

40. Below is the stress profile of tempered glass (See Figures #9 and #10). Approximately, the outer 1/5th of the surface is in compression. The center core is in tension. In order to break this glass by bending, the compressive stresses at the surface must be overcome.

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[36] Kia Sorento Field Reports 2014MY, https://static.nhtsa.gov/odi/inv/2014/INRD-EA14002-61167P.pdf

[37] KMA00014001, KMA00014029, KMA00014057, KMA00014058, KMA00014061, KMA000014066, KMA00014114, KMA00014115

Alternately, if a crack penetrates the compressive layer, the interior tensile stresses in the glass drive the failure, and the glass self-destructs. Any mechanical process that leads to penetration of the compressive layer will cause the glass to fail completely.

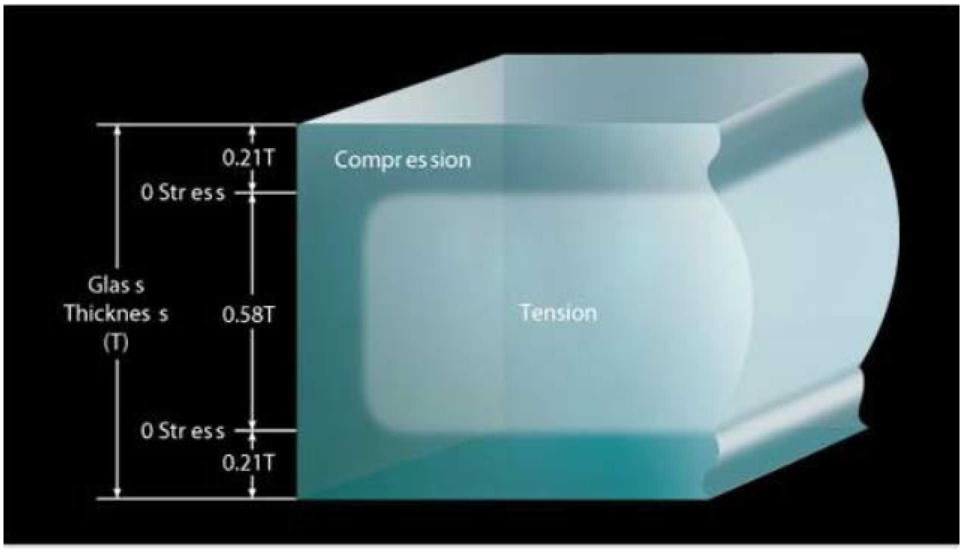


Figure #9: Simplified stress profile of tempered glass.

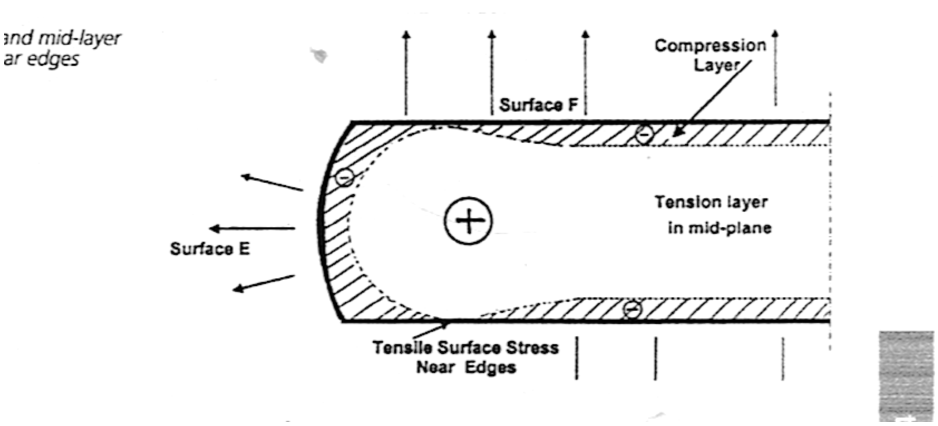


Figure #10: Simplified stress profile of tempered glass near the edge. Because of edge affects the thickness of the protective compression layer is decreased near the edge. Thus, one cannot assume adequate protection from tempering near the edge of the part.

41. Penetration of the compressive layer can be either instantaneous or it can be "progressive" (i.e., the crack grows over time until it has penetrated into the tensile core).

Progressive failures are the result of additional tensile stresses, meaning they are applied after the initial damage has occurred. Kia has acknowledged that failures in Subject Vehicles may be progressive, stating that:

> [An] impact may cause latent damage which will then set up the sunroof for breakage when later events occur, any one or more of which may stress the glass to the point of breakage. Based on a review of incident reports, these events could include vibration caused by driving at high speeds, vibration from driving on rough roads or road disruptions such as railroad tracks, aerodynamic lift, changes in temperature, operation of the sunroof, track obstructions, and weather conditions such as hail or high winds.[38]

42. If surface damage leads to immediate failure, there will be a one-time damage event at origin that starts on the outer surface of the glass and penetrates into the tensile stress region of the glass interior. Applied tensile stresses applied to tempered glass lower the thickness of the compressive layer and make it more vulnerable to immediate failure.

43. Glass failure analysis is the one known and proven technique used to determine the cause of failure of broken glass objects. It began in the early twentieth century. Griffith and others developed the equations of elasticity used to describe quantitatively the fracture of brittle solids, such as glass. In the same time period, Wallner determined how to interpret the markings on glass fracture surfaces to locate the "origin" of the glass failure. More recently, several texts have been written that summarize the necessary techniques used by scientists and engineers to perform glass failure analysis and determine the cause of the failure. Lay persons, automotive technicians, and even engineers, without proper training cannot reliably determine the reason tempered glass failed.

[38] January 10, 2014 response to National Highway Transportation Safety Administration, https://static.nhtsa.gov/odi/inv/2013/INRL-PE13035-58729P.pdf

Reference Texts on Glass Failure Analysis

1. Failure Analysis of Brittle Materials, V. D. Frechette, American Ceramic Society (1990) ISBN 0-944904-30-0.

2. Glass Engineering Handbook, E. B. Shand, Mc Graw-Hill Book Company, Inc (1958).

3. Fractography of Glass, Edited by Bradt & Tressler, Plenum Press (1994).

4. Fractography of Glasses and Ceramics II, Ceramic Transactions, 17, Varner and Frechette, American Ceramic Society (1991).

5. Fractography of Ceramics and Glasses, NIST Publication 960-16.

44. Generally, two steps can be taken to perform glass failure analysis. These are discussed below:

Glass Failure Analysis Stage #1: When possible, assemble the glass pieces to determine the overall crack pattern. Often the crack pattern guides one to the approximate location of the origin. In this case (i.e., tempered glass) the crack pattern initiates at one point and radiates outward (similar to the spokes on a bicycle wheel).

Glass Failure Analysis Stage #2: Stage two is to use markings on the fracture surface (the surfaces created during failure) to trace the cracks back to the "failure origin" and then examine the origin microscopically to determine what led to the failure. Normally Wallner lines on the fracture surface are used for this purpose.

Wallner lines are sets of curved marks that all emanate from the origin. By examining the direction of the curvature of the lines, one can trace backward along the fracture surface to the origin.

45. Wallner lines are formed as a result of an interaction of the moving crack front with sound waves reflecting off artifacts of the fracture surface. Figure #13 illustrates how one class of Wallner line is formed.

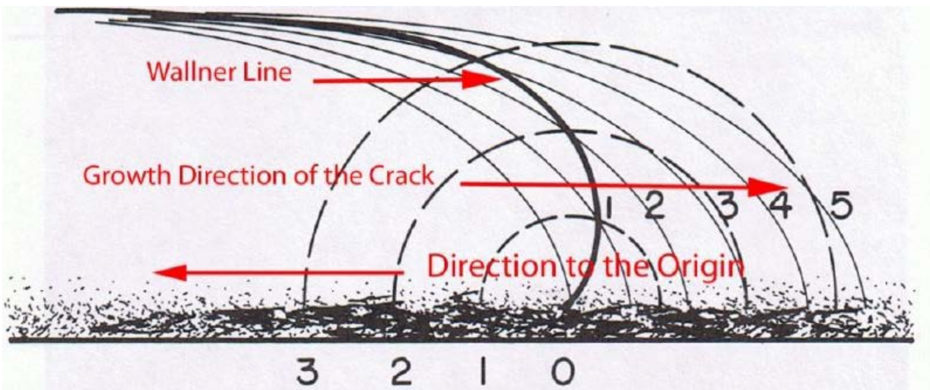


Fig. 2–9. Stages in the production of a secondary Wallner line, caused by mist hackle roughness at the lower edge. Numbered arcs in the sketch show positions of the crack front at successive times; dashed lines show corresponding positions of the (faster) elastic pulse generated at one of the roughness details. The Wallner line is the locus of their intersection.

Figure #11: Formation of secondary Wallner lines. In this case the sound waves associated with cracking interact with defects along the edge of the crack. These sound waves reflect back and interact with the crack front and form the Wallner lines. In this case the crack is moving from left to right. One uses the curvature of the Wallner lines to determine the crack travel direction.

46. Below is a photograph of a tempered soda lime glass toaster oven door that was purposely broken with a spring loaded center punch. This panel was covered with clear tape on the back side, to hold the pieces together, and it was then center punched at the origin. The cracking radiated from the origin, and at the origin is a tell-tale “butterfly”. The failure analysis follows the radiating cracks back to the origin; the pieces at the origin are removed to expose the fracture surface, and the origin is analyzed microscopically to determine the cause.

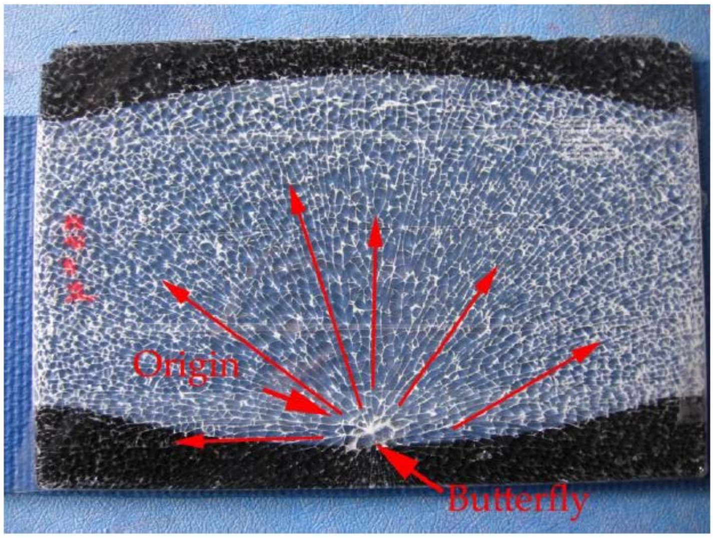


Figure #12: Demonstration of an overall crack pattern. This is a photograph of a tempered glass toaster oven door panel that was broken using a spring loaded center punch that created a crack that penetrated the compressive layer and caused the glass to self-destruct. The cracking radiates from the origin at a speed of 3600 MPH, and the glass panel breaks into a large number of small pieces.

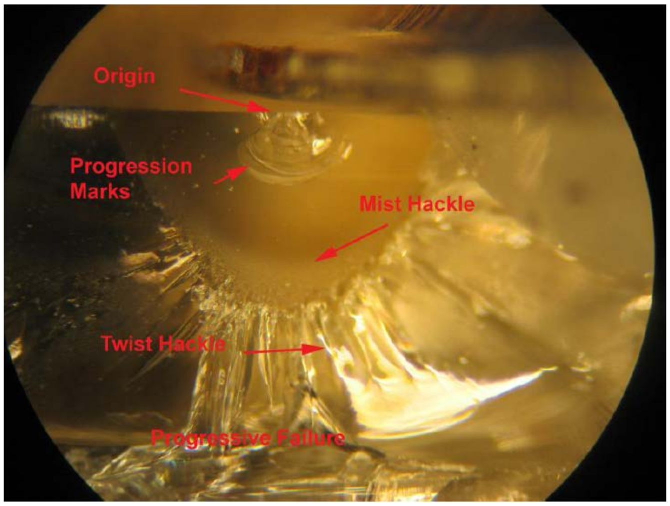


Figure #13: Photomicrograph of a known progressive tempered glass failure. This failure was initiated where a steel cup washer was rubbing on the underside of the tempered glass pot lid. Over time the rubbing combined with thermal cycling created a progressive flaw in the glass that penetrated the outer compression layer into the tensile region and the glass cover self-destructed. This is not an impact failure.

Figure #14: A fully tempered glass panel was impacted with a rock, but the impact did not cause failure. The surface damage is abrasive in nature.

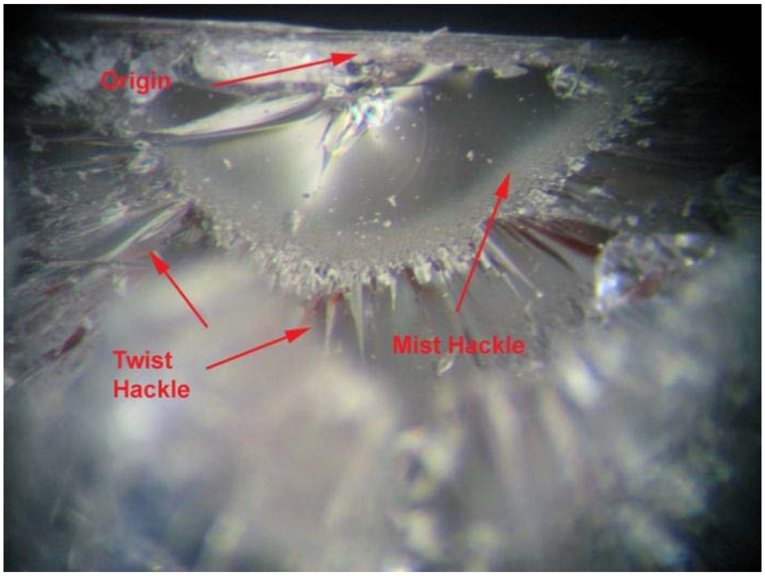
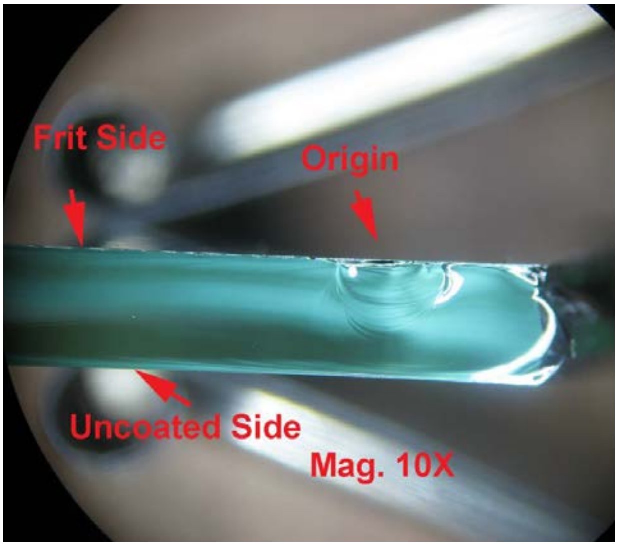
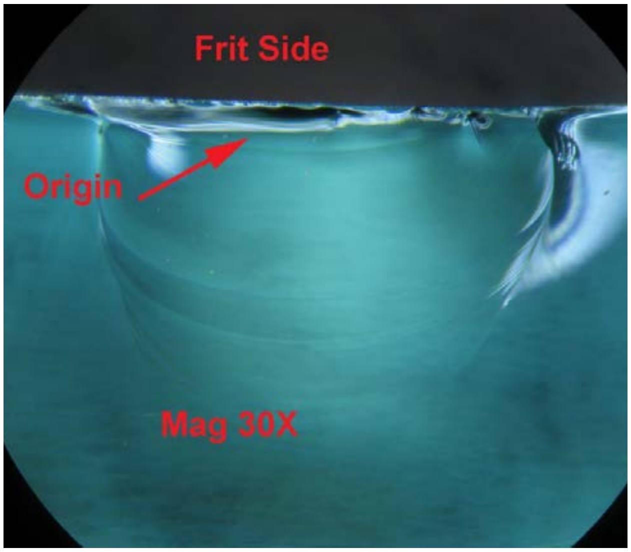


Figure #15: The damaged panel above, also shown in Figure #16, was then put under bending load to failure. The failure originated at the abrasion shown in Figure #16. The origin is shown above. This failure is not progressive in nature. However it demonstrates that post-damage stresses can drive a defect to failure. (Mag. 40X).





Figures #16 and #17: Photomicrographs above showing a thermal shock that initiated a failure under the frit in tempered glass. This demonstrates that the glass in contact with the frit is not fully tempered.

47. Read Consulting reviewed portions of twelve Subject Vehicle panoramic sunroofs at the Exponent facility in Menlo Park. In the course of conducting those inspections, I used the methodology and science discussed above.

48. In my opinion, one of the failures appear to be a direct impact failure. It is my opinion that one of the remaining failures resulted from non-impact tensile stresses on the glass. Ten of the remainder are progressive failures as discussed above. Unlike direct impact failures, there was minimal crushed glass or post failure crushed glass. In addition, there were no apparent "Hertzian cones".

49. The damage observed in these failures did not appear to be abrasive in nature, as depicted in Figure #14.

50. Rather than resulting from major damage from a collision or other substantial impact, Subject Vehicle panoramic sunroofs can, have, and will frequently shatter due to minor impacts combined with the other tensile stresses applied to the glass during normal use.

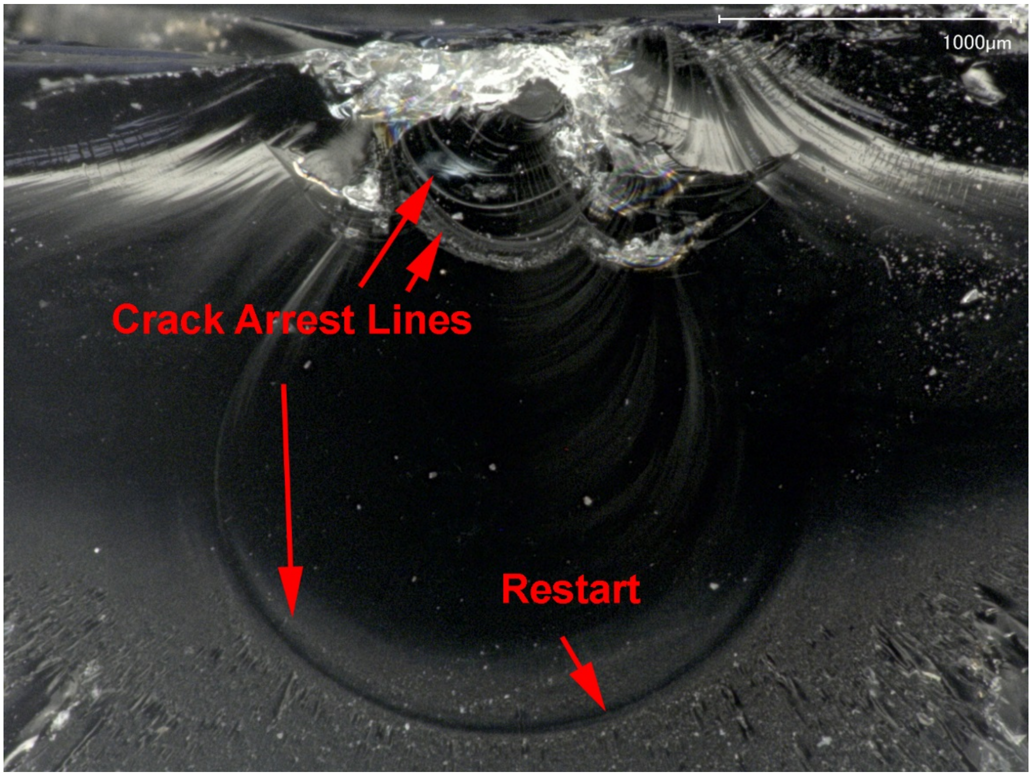


Figure #18: Photo micrograph of the origin of Kia Sample #150901. This is a representative progressive failure that originated as a minor surface defect. Much of the visible damage at the origin (i.e. crushed glass) occurred after failure.

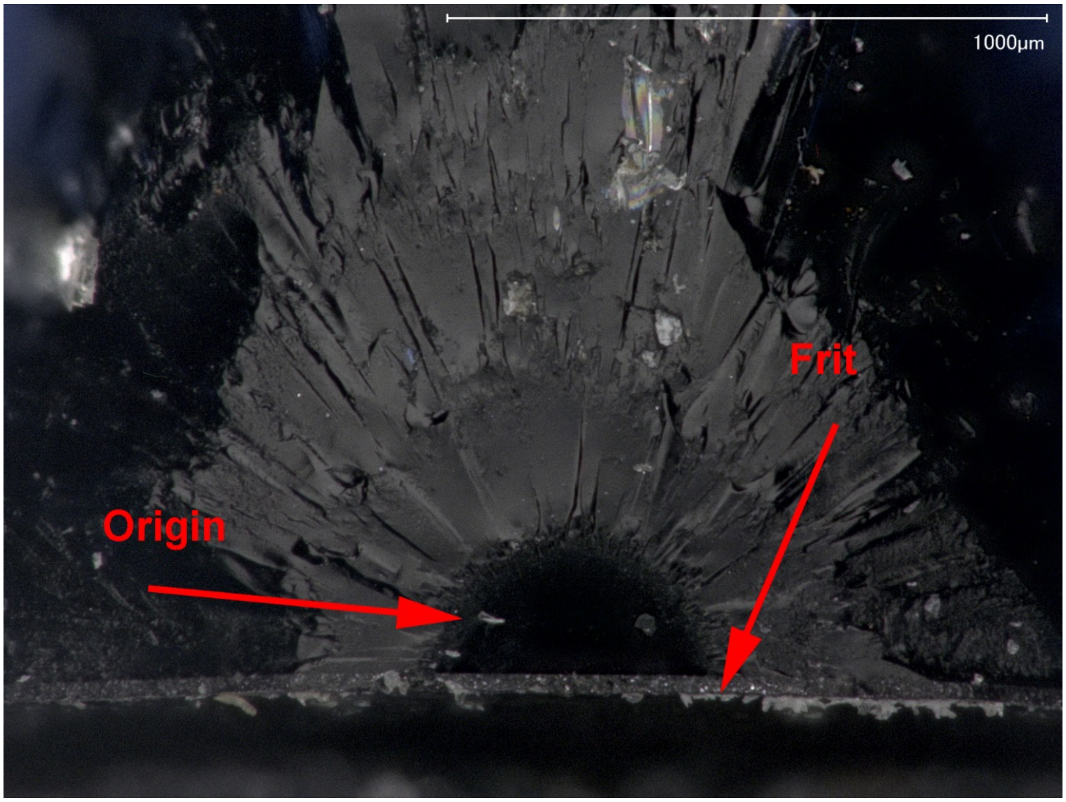


Figure #19: Photomicrograph of the origin of Exponent Kia Sample #160006. This is a failure originating on the frit side of the sunroof due to bending. This is not associated with impact.

51. My inspection of the glass pieces from the Subject Vehicle panoramic sunroofs confirms that the glass is weakened and susceptible to shattering due to application of the ordinary tensile stresses one would expect a sunroof to bear. My inspections corroborated that those stresses can act on any flaw on the sunroof glass surface (e.g., a minor scratch or crack precipitated by a minor impact) and cause the sunroof to shatter. The Subject Vehicles' panoramic sunroofs, in other words, are defective because the common and usual forces acting on their glass can and will cause them to shatter in the environment in which they are expected to perform.

I declare under penalty of perjury of the laws of the United States that the foregoing is true and correct. Executed on July 10, 2017 in Santa Rosa, California.

Thomas L Read

Thomas Read

EXHIBIT 1

READ CONSULTING
THOMAS L. READ, Ph.D.
1435 FULTON ROAD
SANTA ROSA, CALIFORNIA 95403
T 707-494-5089
tread@sonic.net www.readconsulting.com

PROFESSIONAL LICENSE

Registered Professional Engineer: Certificate No. MFOO2174, State of California

SUMMARY OF EXPERTISE

1. Over 40 years of experience as a consultant to attorneys in materials, metallurgy, accident reconstruction, OSHA worker safety, products liability, intellectual property, factory safety and other litigation. This includes numerous depositions and court appearances.
2. 35 years of manufacturing experience in the electronics industry doing processing, process and product introduction, equipment design and build, glass and metal grinding, forming and polishing, part design, machine safety, machine design, quality control, and materials engineering.

ACCIDENT RECONSTRUCTION

User and Worker safety, Product Liability and equipment design (Includes device safety, factory safety and machine guards)

Failure Analysis (Includes both materials and design)

- *Glass Damage & Failures:* Jars, Bottles , Laminated Safety Glass, Windows, Windshields, Wire Glass etc
- *Ceramic and Porcelain Failures:* White Ware, Grinding Wheels, Cutoff Blades and Structural Ceramics
- *Polymer (Plastic) Degradation and Failures:* Piping, Joints, Seals, Packaging, Chairs, Medical Devices, Implants,
- *Metallurgical Failures:* Implants, Pipes, Bolts, Cables, Welds, Gears, Chairs, Prosthetics, Ladders, Plumbing, etc
- *Corrosion Failures:* Galvanic, General; this includes materials selection and electronic devices.
- *Manufacturing Defects:* Any manufactured Item. Tubing failures (metal glass and plastics)
- *Wood Failures:* Chairs, Ladders, Stairs, Window Leaks etc (Includes deterioration from rot).

Manufacturing Expertise: Includes Patents, Tooling, Processing Equipment, Product Design, Factory Safety (Machine Guards), Quality Control, Quality Verification, Reverse Engineering and Factory Procedures

PROFESSIONAL EXPERIENCE

1975 - Present	*Engineering Consultant* in private practice with attorneys and insurance adjusters. Litigation-related practice includes plaintiff and defense clients in approximately equal numbers. Included are numerous depositions and trial appearances.
2001- 2002	Senior Metallurgical Engineer and Safety Engineer Rheodyne, Inc. Rohnert Park, CA
1993 - 2001	Chief Metallurgist Komag Materials Technology Inc., Santa Rosa, California
1988 - 1993	*Senior Thin Film Project Engineer. Thin film Coating Equipment Design* Deposition Sciences Inc., Santa Rosa, California
1984 - 1988	*Thin Film Circuit Engineer, Safety Engineer* and *Reliability Engineer* Microwave Technology Inc., Fremont, California
1975 - 1984	*Project Engineer, Safety Engineer and Project Manager* Hewlett Packard Co., Santa Rosa, California
1974 - 1975	*Senior Project Engineer* Optical Coating Laboratories Inc., Santa Rosa, California
1972 - 1974	*Senior Process Engineer* Corning Glass Works, Coming, New York. Included glass finishing process development and glass failure analysis.
1969 -1972	*Engineering Consultant* Failure Analysis Associates, Stanford, California. Aided engineers with failure analysis.

ACADEMIC DEGREES

1. Stanford University, Ph.D. *Materials Science and Engineering*, 1972
2. Stanford University, MS *Materials Science*, 1969
3. University of Pennsylvania, BS *Metallurgical Engineering*, 1965
4. Diploma, Tercer Curso Panamericano de Metalurgia Nuclear, Buenos Aires, Argentina, 1968

Additional Skills

Fluent in written and spoken Spanish

EXHIBIT 2

Thomas L. Read, PhD.
Read Consulting LLC
1435 Fulton Rd.
Santa Rosa, CA 95403

DEPOSITIONS

1. Bankers v. Kohler, Woodland Hills CA, April 28, 2016
2. Harkey et al. v.General Electric Corp. San Francisco, CA, November 11, 2015.
3. Lexington Insurance v Probuilt Professional Products, Walnut Creek CA, September 30, 2015.
4. South City Lights V City View Marabella, Walnut Creek, CA, July 30, 2015.
5. Manning v Tower 23, February 6, 2015San Diego, CA
6. Gexpro v. International Line Builders, Los Angeles, CA, August 26, 2014
7. Shamsnia v Allstate Insurance, August 21, 2013, El Segundo, CA.
8. Guiterrez v Landavazzo, August 12, 2013, Martinez, CA
9. Gorham v Silaohet-Tone, August 1, 2013, San Francisco, CA
10. Sandoval v Eagle Pizza/Hollman, June 20, 2013, Oakland, CA.
11. Myers v. The Horseshoe Tavern, January 4, 2013, Oakland, CA.
12. Byrd v. Caranica, October 5, 2012, Santa Rosa, CA
13. Zimmerman v. Thomas and Associates, August 30, 2012, Fresno, CA
14. Eddie Horner v. Paneltech et al., May 30, 2012, Santa Rosa, CA.
15. DeLong v Raley's, March 2, 2012, 402 Hearing, Sacramento, CA
16. Ghiaradelli v. Duhig, December 22, 2011, San Francisco, CA
17. Battaglini v. Bravo Bottling LLC, November 29, 2011, Santa Rosa, CA
18. Rich v. State of CA, June,10, 2011, Sacramento, CA
19. Monterey Mechanical v. Goodall Rubber Co. June 5 2011, San Francisco, CA.
20. D. Rae DeLong v Raley's, May 16, 2011, Sacramenta, CA
21. Casey v. Treehan, January 27, 2011, Sacramento, CA

Trials and Court Appearances

1. Bankers v. Kohler, Ventura CA, December 6, 2016
2. Zimmerman v. Thomas, October 2, 2012, Fresno, CA
3. Eddie Horner v. Paneltech et al., September 21 & 24, 2012, Sacramento, CA.

4. Geddie v. Hochmayr, April 20, 2012, Houston TX
5. DeLong v Raley's, March 21, 2012, Sacramento, CA

PROOF OF SERVICE

I am employed in the county of Alameda, State of California. I am over the age of 18 and not a party to the within action. My business address is: 505 14th Street, Suite 1110, Oakland, California 94612.

On July 10, 2017, I served a copy of the foregoing document:

DECLARATION OF THOMAS READ IN SUPPORT OF PLAINTIFF'S MOTION FOR CLASS CERTIFICATION

on the persons below as follows:

Carlos Lazatin
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[_x_] BY EMAIL: by electronically transmitting a PDF version of above listed documents to the email addresses set forth above on this date.

[_x_] BY MAIL: by placing the document(s) listed above for collection and mailing following the firm's ordinary business practice in a sealed envelope with postage thereon fully prepaid for deposit in the United States mail at Oakland, California addressed as set forth above.

I declare under penalty of perjury under the laws of the State of California that the above is true and correct.

Executed on July 10, 2017 at Oakland, California.

A Barber

Alexis Barber